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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

December 4 - December 10, 1998

Summary 98-49

Operating Experience Weekly Summary 98-49

December 4 through December 10, 1998

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EVENTS

1. HAZARDOUS PACKAGING OF DRÄGER INDICATOR TUBES

On December 1, 1998, personnel at the Savannah River Health Physics and Industrial Hygiene Facility recieved a quantity of Dräger halogenated hydrocarbon indicator tubes from a prominent supplier that were improperly packaged in a cardboard box cushioned with packing paper. The pack of tubes had an orange label stating:

WARNING - THESE TUBES CONTAIN A PYROPHORIC MATERIAL (BLACK LAYER) WHICH IGNITES IN THE PRESENCE OF OXYGEN. DO NOT USE IN THE PRESENCE OF COMBUSTIBLE GASES OR DUST. DO NOT DISPOSE OF UNUSED TUBES WITHOUT ACTIVATING THE PYROPHORIC MATERIAL PRIOR TO DISPOSAL.

Site personnel confirmed with Dräger, the indicator tube manufacturer, that the proper way to ship and store the tubes is inside a metal container to prevent ignition of surrounding combustible materials if a tube is broken. Facility personnel stored the tubes in a secure location to avoid unintentional breakage and contacted field industrial hygiene personnel to verify safe storage of existing tubes. (ORPS Report SR--WSRC-HPIH-1998-0003)

A Dräger sampler is a portable instrument used to measure the concentration of a wide range of contaminants in air. Depending on model type, either a hand-operated bellows or an automatic pump draws measured amounts of atmosphere through an indicator tube that is specific to the contaminant of interest. Chemical reactions cause a change in the color of reagents in the indicator tube, and the extent of this color change is proportional to the concentration of the contaminant. Figure 1-1 shows manual and powered Dräger samplers. (Images courtesy of Dräger)

Figure 1-1. Typical Dräger Portable Gas Samplers

Managers of facilities that use Dräger samplers should take steps to ensure that indicator tubes containing pyrophoric material are properly stored. Procurement and industrial health organizations should verify that suppliers of these materials are aware of packaging requirements.

KEYWORDS: analyzer, fire, packaging, pyrophoric, storage

FUNCTIONAL AREAS: Fire Protection, Materials Handling/Storage

2. INADEQUATE OVERPRESSURE PROTECTION FOR EVAPORATOR STEAM SUPPLY

On November 25, 1998, engineers at the Savannah River H-Tank Facility discovered that the flow capacity for a recently replaced steam pressure regulator exceeds the relief capacity of a downstream relief valve. The relief valve provides primary overpressure protection for the steam tube bundle of a high-activity waste evaporator. Backup protection consists of redundant pressure-actuated automatic isolation valves in the steam supply system. An analyzed accident for the facility postulates failure of the waste evaporator tube bundle, followed by failure of the waste evaporator shell and uncontrolled release of a significant quantity of radioactive material. Failure of an oversized pressure regulator in the wide-open position could cause pressure in the tube bundle greater than the value assumed in the accident analysis. Facility personnel shut down the waste evaporator, isolated the affected steam station, and barricaded the area around the steam station. An error in component selection compromised a system important to safety and led to a process shutdown. (ORPS Report SR--WSRC-HTANK-1998-0033)

The pressure regulator reduces service steam pressure from 325 psi to 150 psi. Facility personnel had replaced the pressure regulator during corrective maintenance on November 17, 1998. Engineers discovered the error while they were troubleshooting possible causes of pressure fluctuations in the steam supply to the waste evaporator. They determined that the flow capacity of the replacement pressure regulator is approximately 40,000 lbm/hr, while the capacity of the downstream relief valve is approximately 27,000 lbm/hr. Waste evaporator tube bundle failure could occur at pressures above 171 psi.

The facility manager convened a critique of this occurrence. Participants learned that engineers who specified the replacement regulator believed they were performing a like-for-like replacement based on inspection of the previous regulator. They had selected an equivalent model but had not investigated its flow characteristics, nor did they evaluate the flow relationship between the pressure regulator and the downstream relief valve. Investigators later determined that the previous regulator had an even higher flow capacity than the replacement, and that this condition had existed for an indeterminate period. Engineers are calculating the maximum tube bundle pressure that could have been caused by failure of the previous pressure regulator.

This incident underscores the importance of attention to detail when specifying replacement parts for systems, structures, or components (SSCs) that are important to safety or that can affect SSCs important to safety. Unless SSCs have been incorporated completely into a facility's technical basis, installed equipment cannot be relied on to meet safety design criteria. This is especially true of facilities that were constructed before the advent of modern design standards and controls. Engineers should return to the design-basis stage in support of corrective maintenance or modifications to existing facilities.

DOE 6430.1A, *General Design Criteria*, provides general requirements for the design of DOE facilities. Section 1300-3.1, *Safety Class Criteria - General*, states that special facility SSCs shall be designed, fabricated, erected, and tested to standards and quality commensurate with the hazards and potential consequences associated with the facility itself and with the role of each SSC in mitigating the consequences of design-basis accidents. The Order defines safety class items as SSCs, including portions of process systems, whose failure could adversely affect the environment or the safety and health of the public. It requires appropriately higher-quality design, fabrication, and industrial test standards and codes for safety class items to increase the reliability of the items and allow credit to be taken for their capabilities in a safety analysis. The Order also defines nonsafety class items as those items whose failure will neither adversely affect the environment or the safety and health of the public nor prevent safety class items from performing their required functions.

KEYWORDS: design basis, maintenance, technical safety requirement

FUNCTIONAL AREAS: Configuration Control, Design, Modifications

3. POSITIVE UNREVIEWED SAFETY QUESTION FOR MATERIAL-AT-RISK INVENTORIES

On December 3, 1998, at the Los Alamos National Laboratory Critical Experiments Facility, the facility manager reported that material-at-risk (MAR) inventories are not analyzed in the current safety analysis report, resulting in a positive unreviewed safety question. Investigators are continuing to determine if additional facilities are also affected. MAR is irradiated material that could be released to the atmosphere during a design-basis seismic event that results in a fire. The safety analysis group is performing a qualitative evaluation of the hazards and initial calculation of doses to further evaluate this event. Although no dose consequences resulted from this event, failure to ensure that facility authorization bases are adequate resulted in an unreviewed safety question and could result in unacceptable MAR inventories sitewide. (ORPS Report ALO-LA-LANL-TA18-1998-0013)

The DOE Los Alamos Area Office requested that facility personnel evaluate the MAR currently in the facility versus what was in the facility at the time the safety analysis report was approved by the DOE Albuquerque Area Office. The current safety analysis report was implemented in 1994 but did not include MAR limits for the Critical Experiments Facility. Investigators determined that MAR limits at Kiva 1 (a test reactor) and the Hillside Vault have been maintained by established facility procedural controls. However, they determined that no MAR limits have been established or maintained for Kiva 2 or Kiva 3. They also determined that the actual amount of MAR has increased in Kiva 2 and 3 since the safety analysis report has been implemented, resulting in a positive unreviewed safety question.

The facility manager will develop additional controls in conjunction with the DOE Los Alamos area office following completion of the hazards evaluation. He also directed facility personnel to develop fire-loading limits for all three Kiva reactors and vault areas and establish a fire-loading program to ensure MAR limits are maintained.

NFS has reported authorization bases violations in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-28 reported that an engineer at the Rocky Flats Environmental Technology Plutonium Fabrication Pyrochemical Operations Facility discovered various calculation errors that resulted in the accounting of material-at-risk being underestimated and an operational safety requirement violation of the facility MAR limit. The facility manager directed facility personnel to perform an inventory of MAR. They determined that the amount of MAR present in the facility may have exceeded the limit for an extended period of time. (ORPS Report RFO--KHLL-PUFAB-1998-0048)

- Weekly Summary 97-39 reported that the Hanford reprocessing facility Facility Plant Review Committee determined that an unreviewed safety question existed because ventilation system modifications in 1969 (adding charcoal filters and replacing exhaust fans) were not in accordance with the safety analysis report. The committee agreed that the modifications would cause the filters to collapse during a design-basis fire, leading to an unfiltered radioactive release through the main stack. The safety analysis report accident scenario did not assume failure of the filters. (ORPS Reports RL--PHMC-324FAC-1997-0010 and RL--PHMC-324FAC-1997-0014)

- Weekly Summary 96-51 reported that managers at the Oak Ridge site confirmed an unreviewed safety question for waste stored in a fissile material storage area. During a walk-through, licensing personnel found potentially hazardous, inadequately characterized waste materials in a storage room. A hazards screening performed before the 1994 facility shutdown did not include the room or its contents. (ORPS Report ORO--LMES-Y12NUCLEAR-1996-0026)

These events illustrate the importance of ensuring that hazardous materials are adequately tracked to ensure facilities remain within their authorization bases documents. The Los Alamos event also points out the importance of independently verifying analysis assumptions that are used to maintain material within established safety limits. These reviews are necessary to ensure that no increased risk to the facility, facility personnel, or the public exists. In this event, a design-basis seismic event could have resulted in a radioactive release that seriously compromised the health and safety of workers and the public. In addition, required annual reviews of the safety analysis reports should have identified the discrepancy before 4 years had elapsed.

Facility managers and supervisors should consider implementing configuration management programs to ensure that the facility authorization basis adequately reflects the design basis. Given the age of some facilities, historical information may be difficult, if not impossible, to obtain. A configuration management program would provide personnel responsible for design changes with complete information needed to adequately determine if proposed designs affect the authorization basis.

Facility personnel responsible for completing or approving unreviewed safety question determinations or design changes should review the following Orders and standards to ensure they understand how the authorization bases relate to the design bases and what should be incorporated in a complete safety evaluation. Facility managers should review the following information and should communicate to facility personnel the importance of ensuring that facility design bases are adequately reflected in authorization bases documents.

- DOE O 5480.21, *Unreviewed Safety Questions*, establishes program requirements to evaluate the impact of changing conditions that may affect authorization bases. It also ensures that DOE has the approval authority for changes that introduce new hazards and higher-than-approved risks to the public and facility workers. The Order states that the following three criteria are used to identify unreviewed safety questions when changes are made to the facility: (1) if the probability of occurrence or the consequences of an accident that is analyzed in the safety analysis report are changed; (2) if the possibility of an accident of a different type than analyzed in the report may be created; and (3) if the margin of safety, as defined in any technical specification, is reduced.

- DOE O 5480.23, *Nuclear Safety Analysis Reports*, states that it is DOE policy that nuclear facilities and operations be analyzed to (1) identify all hazards and potential accidents associated with the facility and the process systems, components, equipment, or structures and (2) establish design and operational means to mitigate these hazards and potential accidents. The results of these analyses are to be documented in safety analysis reports.

- DOE-STD-1073-93, *Guide for Operational Configuration Management Program,* provides program criteria and implementation guidance for establishing consistency among design requirements, physical configuration, and facility documentation and for maintaining this consistency. This standard states that an effective configuration management program will increase the availability and retrievability of accurate information to support safe, sound, and timely decision-making related to facility design and operations.

- DOE/EH-0502, Safety Notice 95-02, *Independent Verification and Self-Checking.* This notice provides guidance and good practices for performing independent verification. Safety Notice 95-02 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: calculations, unreviewed safety question, safety analysis, safety analysis report

FUNCTIONAL AREAS: Licensing/Compliance, Configuration Control, Fire Protection, Nuclear/Criticality Safety, Technical Support

4. FAILURE TO LOCK OUT/TAG OUT PRESSURIZED AIR SUPPLY LINE

On December 4, 1998, at the Rocky Flats Environmental Technology Site, pipe fitters loosened a connection to bleed off residual air in an air supply line and realized that the line was still pressurized and not locked out or tagged out. They were performing maintenance to remove the air actuator from an air-operated valve when they discovered that one of two air supply lines that they were working on was not isolated. They retightened the connection, stopped work, and notified the configuration control authority. Investigators determined that no one had performed a system walk-down to ensure all system isolation points were identified and locked out and tagged out before the pipe fitters began work, violating site health and safety procedures and lockout/tagout programs. Failure to adhere to procedures and established lockout/tagout programs can place personnel, equipment, and the environment at risk. (ORPS Report RFO--KHLL-771OPS-1998-0048)

Investigators determined that the configuration control authority, the evolution supervisor, and the cognizant engineer reviewed the work package and that they believed that it provided lockout/tagout details to isolate two air supply lines. The engineer determined after the event that the work package provided isolation for only one of the lines. Investigators determined that from the time work planners began the work package preparation to the time they finished it, the requirements for including isolation points in the work package changed because of a policy change. Originally, work planners were to include all isolation points in the work package. Investigators determined that the requirement changed, so that isolation points are controlled by lockout/tagout procedures and are not required to be detailed in the work package. The work planners included the isolation points for one of the air supply lines in the work package, but when the requirement changed they left out the other air supply line. Investigators determined that the work package should have been revised to be consistent with current policies and procedures. They believe that including isolation points in the work package for one air supply line and not the other may have caused confusion.

The facility manager held a fact-finding meeting on this event. Meeting attendees learned that site health and safety procedures and lockout/tagout procedures require lines pressurized to 30 pounds or greater to be locked out and tagged out with two valve isolation points. They also learned that the air supply line was pressurized at 90 psig. Meeting attendees learned that the work package reviewers should have been more rigorous in their review and they should have noted that isolation points for one line and not the other were included. They learned that lockout/tagout procedures require facility personnel to perform a system walk-down to ensure all isolation points are identified and locked out and tagged out before work begins and that no one performed such a walk-down. The facility manager will develop corrective actions as necessary.

NFS has reported in several Weekly Summaries events where pressurized lines and equipment were not locked out and tagged out. Following are some examples.

- Weekly Summary 98-02 reported that subcontractors at the Hanford Site removed a valve from steam piping and reinstalled it while the valve was an isolation point for a lockout/tagout. They removed the valve with its tag and physical locking mechanism still installed. This violated the site lockout/tagout program. Fortunately, no steam was being supplied to the line where the workers were removing the valve because the steam source was in an outage. (ORPS Report RL--PHMC-200LWP-1998-0001)

- Weekly Summary 97-50 reported that an L-Reactor facility operator at the Savannah River Site installed a lockout on the wrong lockout point for maintenance on a compressed air system. Independent verification of the lockout failed to catch the error. (ORPS Reports SR--WSRC-REACL-1997-0013)

- Weekly Summary 97-45 reported several lockout/tagout events. OSHA inspectors at Oak Ridge National Laboratory observed that millwrights had not reverified a single-point lockout before resuming repair work. Maintenance mechanics at the Idaho National Engineering and Environmental Laboratory installed a lockout/tagout on an instrument air line, then cut an adjacent, but incorrect, air line. (ORPS Reports ORO--ORNL-X10PLEQUIP-1997-0011 and ID--LITC-SMC-1997-0007)

These events underscore the importance of using an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analyses must be included in the work control process to help prevent worker injury. The hazard analysis process should include provisions for lockouts/tagouts, job-specific walk-downs, integration of work activities, and personnel protective equipment. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with job-specific activities. Maintenance personnel should ensure that equipment is properly locked and tagged out before performing maintenance or troubleshooting activities. In the Rocky Flats event, the pipe fitters were paying attention to detail. They noticed that the line pressure was not bleeding off and took the appropriate action when they stopped work and reported the event, thereby eliminating any chance that they could be injured.

This event also demonstrates the importance of multiple engineered barriers to prevent hazardous events. Although human performance (supported by procedures, policies, memoranda, or standing orders) is a standard barrier to preventing mechanical rotating hazards, pressurized component hazards, and electrical shocks, the probability of prevention can be increased by adding physical barriers such as lockouts and tagouts.

A good lockout/tagout program is an important element of an effective conduct of operations program. Lockout/tagout programs in DOE serve two functions. The first function, defined in both 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. Lockouts/tagouts are typically applied during maintenance activities; however, there are many cases when lockouts/tagouts are needed for personnel safety. The standard states that an effective lockout/tagout program requires three elements: (1) all affected personnel must understand the program; (2) the program must be applied uniformly in every job; and (3) the program must be respected by every worker and supervisor.

Managers and supervisors in charge of job performance should ensure that hazards are identified and corrected. DOE facility managers should ensure that personnel understand the basics of work control practices and safety and health hazard analyses. Personnel in charge of system design changes should ensure that facility documentation, including drawings, is updated and accurate. Following are some of the many documents that facility managers should review to ensure they are incorporated in current facility safety programs.

- DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that experience has shown that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events.

- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, section 1, "Introduction," states that the primary purpose of lockout/tagout programs is to protect employees from exposure to potential hazardous energy sources. This standard also states that lockout/tagout programs promote safe and efficient operations and are an important element of conduct of operations programs.

- DOE-STD-1073-93-Pt.1 and -Pt.2*, Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control.

- DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, provides guidance for enhancing worker, public, and environmental safety. This standard supports integrated safety management system principles to guide the safe accomplishment of work activities. These principles include (1) line management responsibility for safety; (2) clear roles and responsibilities; (3) competence commensurate with responsibilities; (4) balanced priorities; (5) identification of safety standards and requirements; (6) hazard controls tailored to work being performed; and (7) operations authorization.

- DOE/EH-0540, Safety Notice 96-05, *Lockout/Tagout Programs,* summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements.

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. The guide also provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

DOE technical standards are available at http://www.doe.gov/html/techstds/techstds.html. OSHA regulations are available at http://www.osha-slc.gov/OshStd_data. Safety Notice 96-05 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. A copy of the *Hazard and Barrier Analysis Guide* is also available from the ES&H Information Center or at http://tis.eh.doe.gov:80/web/oeaf/tools/hazbar.pdf.

KEYWORDS: conduct of operations, maintenance, personnel error, procedures

FUNCTIONAL AREAS: Maintenance, Procedures, Industrial Safety, Hazards Analysis, Work Control

5. MISPOSITIONED VALVE CAUSES INADVERTENT SPRINKLER SYSTEM ACTIVATION

On December 1, 1998, at the Savannah River Tritium Facility, low pressure in a dry pipe deluge system for a cylinder storage shed caused activation of a sprinkler system. The ventilation system responded as designed by shutting down all but two building exhaust fans. The incident occurred several hours after operators had placed the system into service following a shutdown for routine testing. Investigators believe the operators who restored the system may have left an air charging valve closed, allowing pressure to gradually bleed off. The fire department responded to verify that no fire existed, shut off the sprinkler system, and reset the fire protection system. Operations personnel restarted ventilation fans. Although no water damage to materials or equipment occurred during this event, it was significant because any unplanned activation of a fire sprinkler system is capable of causing extensive water damage and process interruption. (ORPS Report SR--WSRC-TRIT-1998-0018)

The sprinkler system is a supervised dry pipe system. Figure 5-1 shows a simplified dry-pipe activation valve arrangement. Fire system water pressure acts against one side of a clapper valve, and air pressure acts against the other side to keep it closed. The air side supplies a normally dry header equipped with fused sprinkler heads. When the heat of fire activates any sprinkler head, air pressure vents through the head more rapidly than the air supply system can deliver makeup. At a predetermined low pressure, the clapper valve unbalances and admits water to the riser, allowing it to flow from the open sprinkler head(s). The cylinder shed fire system also contains a set of sprinkler headers with open heads that are flooded automatically through a relay valve when the closed-head system activates. It is through this open-head system that water was admitted to the cylinder shed.

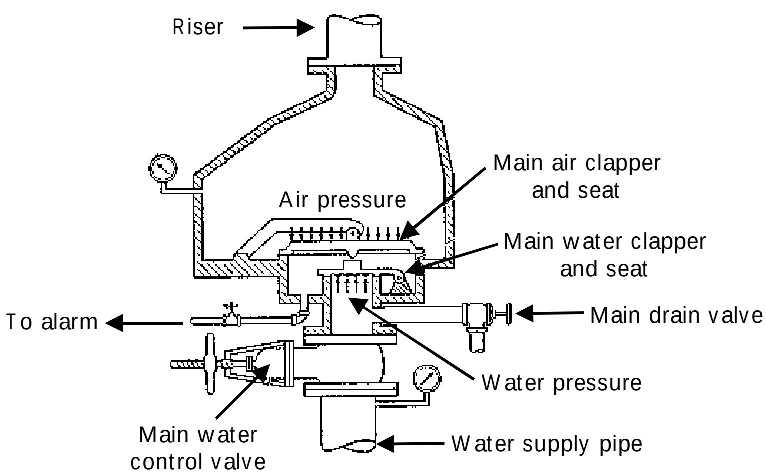

Figure 5-1. Typical Dry-Pipe Activation Valve

Facility personnel learned the following during a critique of the occurrence.

- The control room received a low header pressure alarm during the evening preceding the activation. A person dispatched by the fire department could not determine the cause for the alarm and recommended that investigation be deferred until day shift personnel reported for work. At approximately 0700, a low-low pressure alarm occurred, coincident with activation of the sprinkler system.

- Immediately after the occurrence, operations personnel found the normally open air charging valve in the closed position. The valve is required to be open to make up for normal system losses. Operators had closed both a water supply valve and the air supply valve to support routine testing of system low-pressure alarms. The operator who restored the system opened the air supply valve to charge the dry-pipe sprinkler headers but does not remember reclosing it. However, he does acknowledge having been involved in concurrent activities at the time.

OEAF engineers searched the ORPS database for inadvertent sprinkler system activation and located several occurrences related to loss of pressure in dry-pipe systems. The following are some examples.

- At the Oak Ridge Plutonium Processing and Handling Facility, a dry-pipe sprinkler system activated because of low air pressure in the sprinkler piping. The activation charged the header and water leaked from the alarm line into a radiologically contaminated area. Investigators discovered that the air supply valve was only partially open and cited personnel error as the root cause of the event. The system had been returned to service 3 days earlier, following repairs. (ORPS Report ORO--MMES-PGDPOPERD-1990-0040)

- At the Mound Plant Tritium Facilities, a loss of air pressure to the dry side of a dry-pipe sprinkler system riser valve caused activation of the system. Investigators determined that air had leaked from a rubber valve seal on the clapper valve while air compressors that supply air to the system were shut down for an extended period. (ORPS Report OH-MB-EGGM-EGGMAT01-1995-0032)

These occurrences underscore the degree of attention that must be given to fire protection systems. The direct cause of the occurrence at Savannah River is the decrease of dry-pipe header pressure caused by a closed makeup air valve. Although investigation is incomplete, contributing and root causes and long-term corrective actions are likely to involve conduct of operations issues.

It is possible that the makeup air valve was closed through operator error. There are two principal defenses against error during system alignments or operation. The first is to plan work and staff activities in a way that allows an operator to give undivided attention to the task at hand. Involvement in a number of tasks at the same time significantly increases the risk of error. The second defense is to provide for independent verification of critical steps in task procedures.

The shift superintendent did not recognize the significance of the low pressure alarm and allowed the condition to continue until the system activated. Persons in charge during off-hours cannot be expected to have all of the technical knowledge that is needed to address potential problems. However, facility managers should ensure that their allocation of resources includes qualified personnel for support of off-shift working hours, as well as weekends and holiday periods.

KEYWORDS: activation, conduct of operations, sprinkler, valve

FUNCTIONAL AREAS: Conduct of Operations, Fire Protection, Operations

FINAL REPORTS

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. VALVE POSITION STOP PLATE FAILURE RESULTS IN MISROUTED CONTAMINATED LIQUID WASTE

On August 19, 1998, at the Oak Ridge National Laboratory, low-level contaminated liquid waste was misrouted because of a valve alignment problem. Facility personnel at the sending and receiving organizations noted indications of a proper transfer, but at the end of the transfer, the receiver noted that the anticipated volume had not accumulated in the low-level liquid waste system. Personnel from both organizations conducted system alignment and radiological checks to search for the missing volume and reviewed system drawings. They determined that some of the liquid waste had been routed to the process waste system instead of the liquid waste system. Inadvertent transfers of solutions can result in tank overflows, mixing of incompatible chemicals or solutions, contamination of clean systems, and discharges to the environment. (ORPS Report ORO--ORNL-X10CHEMTEC-1998-0006)

Investigators determined that a ball valve in the low-level liquid waste discharge line that was supposed to be fully open was partially closed. As a result, some of the liquid waste backed up into a steam eductor that serves as an alternative means of moving the liquid waste. The eductor is vented to the process waste system. Liquid waste traveled through the eductor vent path into the process waste system, which can handle only limited quantities of low-level liquid waste. Radiological control technicians surveyed affected areas and determined that there was no uncontrolled spread of contamination. Waste operations personnel collected samples and made process changes at the treatment facilities to minimize impacts to the treatment systems.

The facility manager concluded that the direct and root cause of the ball valve alignment problem was a failure of the valve position stop plate, which allowed operators to turn the valve past the fully opened position to a partially closed position without the operators' knowledge. Operators manipulate the valve remotely using a reach rod, and they rely on feel to tell them when the valve is fully open or fully closed. The facility manager determined that a contributing cause of the inadvertent transfer was the design of the low-level liquid waste piping system. The connection between the low-level liquid waste system and the process waste system through the eductor vent line provided an unmonitored pathway for transfers between the systems.

The facility manager specified corrective actions to address the causes of the inadvertent transfer of low-level liquid waste to the process waste system. These actions included redesigning the valve position stop plate so that it is more robust and making a valve position indicator that is visible to the operator. Facility personnel are also addressing the unmonitored cross-connection between systems through the eductor.

NFS has reported similar events involving valve positioning in the Weekly Summary. Following are some examples.

- Weekly Summary 98-38 reported that operators at the Savannah River Site aligned the reach rod handle for a plutonium processing system ball valve to the closed position in accordance with valve labeling, but the valve was actually open. The open valve diverted flow around the next process stage and resulted in a process interruption. Investigators determined that maintenance personnel had reoriented the valve operating mechanism but did not modify valve position labeling or notify operating personnel. (ORPS Report SR--WSRC-FBLINE-1998-0026)

- Weekly Summary 97-31 reported that an operator performing a valve lineup to recirculate the contents of a tank at the Savannah River Site incorrectly determined the tank inlet valve was closed when it was actually open. This condition allowed acid to transfer to a tank that was supposed to be isolated. The operator thought the valve was closed because the valve handwheel would not turn. (ORPS Report SR--WSRC-HCAN-1997-0031)

Inadvertent transfers cause several concerns. For example, solutions containing fissile materials may be subject to inadvertent criticality. Also, for many solutions, there are concerns about reactions between incompatible chemicals. These reactions may result in explosive, corrosive, or gas-generating mixtures. Another area of concern is the potential for off-site release of radiation or hazardous chemicals.

The recent inadvertent transfer at Oak Ridge National Laboratory occurred, in part, because the valve position stop plate failed. While the valve position stop plate was probably adequate for normal hand manipulation, it was not adequate when manipulated using reach rods, when the feel of resistance against a mechanical stop is the only indication to the operator that the valve is either fully open or fully closed. Facility managers should be aware that valve position stop plates on ball valves are typically designed for only light hand pressure and may fail when manipulated by operators using reach rods or other devices that can offer a mechanical advantage.

Guidance on equipment selection may be found in DOE O 414.1, *Quality Assurance.* This document specifies criteria for design, procurement, inspection, and acceptance testing. These criteria discuss controls for selection and determination of the suitability of purchased items. Other guidelines for parts procurement can be found in DOE-STD-1071-94, *Guidelines to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities*.

KEYWORDS: operations, transfer, valve

FUNCTIONAL AREAS: Operations, Chemistry

2. WELD MATERIAL EJECTED FROM CADWELD MOLD

On September 24, 1998, at the Pantex Balance-of-Plant Facility, an explosion ejected weld material from a Cadweld crucible mold while contractors were installing ground cables for new air conditioning equipment. The weld material ignited a grass fire at the base of an explosives magazine, and wind spread the fire to a second location on the slope of the magazine. Fire watch personnel extinguished both fires using portable fire extinguishers. The fire burned an area of approximately 1,400 square feet. Molten weld material landed on safety goggles worn by the electrician who performed the welding operation and on other personnel in the area without injuring anyone. The electrician did not follow the manufacturer's recommendation to ensure that the conductors were dry before applying the weld. This occurrence caused a ground fire in close proximity to a storage area for high explosives. (ORPS Report ALO-AO-MHSM-PANTEX-1998-0068)

Cadweld is the trade name of an exothermic process for welding copper to copper or copper to steel. A premeasured charge of granular materials, typically copper oxide and aluminum, is placed in a graphite crucible and ignited. A rapid chemical reaction produces molten metal that flows from the crucible to a mold section, where the heat of the molten metal is sufficient to fuse with and join the ends of the conductors. The process results in a strong molecular bond with good current-carrying capacity. Any moisture in the crucible, mold, or conductors will flash to steam, which could cause a failure of the containment system or a forcible ejection of molten metal.

Investigators determined that the direct cause of this occurrence was the presence of moisture in the copper cables being welded. They believe that moisture entered the cable ends because they had been in contact with ground dampened by recent rains. They cited failure to use procedures correctly as the root cause of the occurrence. The electrician inspected the copper wires visually to verify the absence of moisture but did not heat the wire ends with a torch or hot air blower to drive out moisture, as recommended by the manufacturer. Investigators identified inattention to detail as a contributing cause. The manufacturer recommends discarding Cadweld crucible molds after 50 welds because deterioration in their strength and composition makes them less likely to contain weld material safely. The contractor had not been tracking usage data for Cadweld crucible molds, but investigators believe that at least 75 welds had been performed with the mold that failed. Although it had no direct bearing on the event, investigators also determined that the safety work permit for the job did not authorize exothermic welding because the contractor had not identified exothermic welding as a hazard.

NFS reviewed another occurrence where inattention to manufacturer's recommendations presented a hazard to employees. At the Los Alamos National Laboratory Radiochemical Site, two employees unpacking waste drums were lacerated by flying glass when an unvented 2-liter bottle ruptured. Each employee required seven stitches to the left hand. Investigators determined that the bottle contained a solution of Nichromix glass cleaner in sulfuric acid, a mixture commonly used to clean laboratory glassware. They also determined that both the material safety data sheet for Nichromix and the manufacturer's mixing instructions strongly warn against storing the solution in unvented containers. (ORPS Report ALO-LA-LANL-RADIOCHEM-1996-0008)

Corrective actions for this occurrence, which should be considered for all facilities that use Cadweld processes, included the following.

- Contractor and facility personnel attended safety meetings that addressed proper Cadwelding procedures, the need to follow instructions, and the need to use tools in the manner recommended by the manufacturer.

- Facility managers revised master contract specifications to require contractors to use and maintain tools and to apply materials in accordance with manufacturers' instructions.

- Site managers issued a memorandum requiring all contractors to wear full-face shields during Cadweld operations.

This occurrence underscores the importance of incorporating manufacturers' instructions into procedures for the use of tools, equipment, and materials. In addition, work planning must consider the degree of hazard presented by each element of a job or task, regardless of the level of confidence placed in the skill of the craft.

KEYWORDS: industrial safety, maintenance, work control

FUNCTIONAL AREAS: Electrical Maintenance, Industrial Safety, Work Planning

PRICE-ANDERSON AMENDMENTS ACT (PAAA) INFORMATION

1. PRELIMINARY NOTICE OF VIOLATION AND PROPOSED CIVIL PENALTY FOR OPERATIONAL CONTROL FAILURES

On November 16, 1998, the DOE Office of Enforcement and Investigation issued a Preliminary Notice of Violation under the Price-Anderson Amendments Act to Lockheed Martin Energy Research (LMER) for three events that involved work process and quality improvement deficiencies. The Notice proposes a $123,750 fine against LMER for violations that occurred between May 1997 and January 1998 in the High Flux Isotope Reactor at the Oak Ridge National Laboratory. The Office of Enforcement and Investigation conducted the investigation and determined that the deficiencies involved ongoing and repetitive failures to adhere to operational controls that ensure reactor operations are conducted within appropriate safety margins and in accordance with facility authorization bases. Investigators stated that they were particularly concerned because LMER personnel failed to recognize the programmatic safety significance of the issues. (NTS Report NTS-ORO--ORNL-X10HFIR-1998-0001; Letter, DOE (P. Brush) to Lockheed Martin Energy Research Corporation (A. Trivelpiece), 11/16/98)

The Office of Enforcement and Investigation staff identified multiple deficiencies and classified them as Severity Level II violations in the Preliminary Notice of Violation. Severity Level II violations are significant violations that demonstrate a lack of attention or carelessness toward safety that could potentially lead to adverse impacts. Investigators determined that these deficiencies represent potential violations of 10 CFR 830.120, “Quality Assurance Rule.” The Notice describes violations that involved (1) a loss of cadmium nitrate event, (2) inadvertent actuation of an emergency depressurization system, and (3) gradual deterioration of emergency backup reactor cooling pump motors. Investigators were concerned because these violations were not isolated incidents and occurred at multiple locations and involved several organizations within the facility. Following are some examples of the preliminary violations cited in the Notice.

CADMIUM NITRATE VIOLATIONS

Investigators determined that an operator error caused a dilution and overflow of a cadmium nitrate tank (used for backup emergency reactor shutdown system), which required a precautionary reactor shutdown. This event resulted in reactor operation outside the facility authorization basis, because the required amount of cadmium was not present in the system. They proposed a collective civil penalty of $41,250 for the following violations.

- Operators periodically filled the cadmium nitrate tank without a procedure.
- An operator performed his rounds by relying on his memory for items to be checked and did not use the required check-sheet, which details 45 checks to be made with approximately 13 numerical values to be recorded. He completed the check-sheet in the control room after completing his rounds.
- For several hours, no one ensured that the required cadmium nitrate tank level was maintained, resulting in the tank maximum level being exceeded for several hours.
- For several hours, no one ensured that the required cadmium nitrate inventory was maintained, resulting in less than the required inventory while the reactor was at full power.

- While filling the cadmium nitrate tank, an operator left it unattended, contrary to procedures, which require operators to remain in their immediate area of responsibility until properly relieved, to be responsible for monitoring instrumentation and controls, and to be responsible for taking actions to ensure safe facility operation.

EMERGENCY DEPRESSURIZATION SYSTEM VIOLATIONS

Investigators determined that the following work control failures were of concern because of failure to maintain the primary coolant system temperature, which would have resulted in an unplanned release of radioactive material. They proposed a collective civil penalty of $41,250 for the following violations.

- Personnel performed insulation resistance testing on emergency backup reactor cooling pump motors without a procedure for starting and stopping the motors.

- Personnel did not maintain the correct primary reactor cooling system temperature while the system was under pressure, resulting in an emergency depressurization system actuation.

- An operator energized an emergency backup reactor cooling pump motor without notifying the proper personnel for the appropriate authorizations, resulting in an emergency depressurization system actuation.

- A console operator failed to notice decreasing heat exchanger coolant temperatures after the emergency backup reactor cooling pump motors had been shut down.

- Personnel continued to test the emergency backup reactor cooling pump motors without required management approval even after one test resulted in an emergency depressurization system actuation.

EMERGENCY BACKUP REACTOR COOLING PUMP MOTOR VIOLATIONS

Investigators determined that operators relied on seriously degraded emergency cooling pump motors over many reactor operating cycles without documenting, analyzing, or correcting the condition in a timely manner. Specifically, they determined that actions initiated did not identify nonconforming conditions for a long-term trend of deterioration and multiple motor failures that existed. They also determined that personnel failed to adhere to approved test procedures when they reduced an electrical resistance test duration based on oral directions. Investigators proposed a collective civil penalty of $41,250 for these violations.

Investigators reduced the base civil penalties ($55,000 for each violation) by 25 percent because they believed that LMER fully assessed the problems and their sitewide implications. They also recognized that LMER took significant actions to address the issues. However, they did not consider full mitigation appropriate because correction action effectiveness has not been adequately demonstrated, specifically with respect to (1) personnel/organizational changes, (2) lessons learned, (3) trending of programmatic deficiencies, and (4) the assessment program.

LMER management has 30 days to reply to the Preliminary Notice of Violation and Proposed Imposition of Civil Penalty and admit or deny the alleged violations. The Preliminary Notice of Violation will become final if they admit the allegations and provide sufficient corrective actions within the 30-day period. Enforcement actions can be found at the Office of Enforcement and Investigation website at http://tis-nt.eh.doe.gov/enforce/.

NFS has reported recent Notices of Violations under the Price-Anderson Amendments Act in Weekly Summaries 98-42, 98-41, 98-40, 98-26, 98-15, and 98-11.

Under the provisions of the Price-Anderson Amendments Act, DOE can fine contractors for violations of Department rules, regulations, and compliance orders relating to nuclear safety requirements. DOE contractors who operate nuclear facilities or perform nuclear activities and fail to remain in compliance with such requirements could be subjected to Price-Anderson civil penalties under the provisions of 10 CFR 830.120, *Quality Assurance Requirements,* and/or 10 CFR 835, *Occupational Radiation Protection*. These actions include Notices of Violation and, where appropriate, nonreimbursable civil penalties.

The primary consideration for determining whether DOE takes enforcement action is the actual or potential safety significance of the violation, coupled with how quickly the contractor acts to identify and correct problems. The Office of Enforcement and Investigation may reduce penalties when a DOE contractor promptly identifies a violation, reports it to DOE, and undertakes timely corrective action. DOE has the discretion to decide not to issue a Notice of Violation in certain cases.

The Noncompliance Tracking System (Weekly Summaries 95-17 and 95-20) provides a means for contractors to promptly report potential noncompliances and take advantage of provisions in the enforcement policy. DOE-STD-7501-95, *Development of DOE Lessons Learned Programs*, discusses management responsibility for incorporating appropriate corrective actions in a timely manner.

KEYWORDS: enforcement, Price-Anderson Act, quality assurance, radiation protection, procedures

FUNCTIONAL AREAS: Lessons Learned, Management, Radiation Protection, Procedures